

## MICRONEEDLES FOR MINIMALLY INVASIVE DRUG DELIVERY

### Abstract of the Disclosure

The present invention provides a microneedle incorporating a base that is broad relative to a height of the microneedle, to minimize breakage. The  
5 microneedle further includes a fluid channel and a beveled non-coring tip. Preferably arrays of such microneedles are fabricated utilizing conventional semiconductor derived micro-scale fabrication techniques. A dot pattern mask is formed on an upper surface of a silicon substrate, with each orifice of the dot pattern mask corresponding to a desired location of a microneedle. Orifices are  
10 formed that pass completely through the substrate by etching. A nitride pattern mask is formed to mask all areas in which a nitride layer is not desired. A nitride layer is then deposited on the bottom of the silicon substrate, on the walls of the orifice, and on the top of the silicon substrate around the periphery of the orifice. The nitride layer around the periphery of the orifice is offset somewhat, such that  
15 one side of the orifice has a larger nitride layer. Anisotropic etching is used to remove a substantial portion of the substrate, creating a plurality of angular, blunt, and generally pyramidal-shaped microneedles. A subsequent removal of the nitride layer, followed by an isotropic etching step, softens and rounds out the blunt angular microneedles, providing generally conical-shaped microneedles.  
20 The uneven nitride layer adjacent the orifice ensures that the microneedles will include a beveled tip. Such microneedle arrays are preferably incorporated into handheld diagnostic and drug delivery systems.